

Appendix H.
San Francisco Terminal Alternatives

San Francisco Terminal Alternatives

A conceptual engineering and operational analysis was performed for several San Francisco HST terminal alternatives. The alternatives are various combinations of HST and Caltrain service to the Transbay Transit Center (TTC), the 4th and King Terminal and the Beale Street Terminal. Both the Transbay Transit Center and Beale Street terminals include a new three-track main line starting near the 4th and King Terminal, and include a below-grade two-track center 800-ft long platform for Caltrain trains in the underground section adjacent to the 4th and King Street surface terminal.

In the first step of the analysis, each alternative was reviewed for basic engineering and operational feasibility. If an alternative warranted further analysis, conceptual track and platform layouts were developed and reviewed for functionality and constructability. Finally, if an alternative appeared to be viable, it was analyzed operationally to estimate its ability to support the draft conceptual 2035 service levels for both the HST and Caltrain. (See Appendix K for a detailed description of the operational analysis).

1. **Transbay Transit Center Only:** In this alternative, there are a total of six platform tracks for the HST at the Transbay Transit Center. In the Alternatives Analysis, this scenario is designated Option 0(b)A and is the preferred San Francisco terminal alternative selected in the program-level analysis. Three approach interlocking¹ “throat” tracks provide universal² access to all station platform tracks. The existing terminal at 4th and King Streets would remain in its current configuration. This layout is shown in Figure 1. Caltrain operations are assumed to originate and terminate at Fourth and King Terminal and therefore were not part of the operational analysis of this alternative. This alternative did not provide sufficient capacity for HST operations.

2. **4th and King Only:** This alternative terminates all HST service at the existing 4th and King Terminal. There are a total of eight platform tracks for the HST at the Fourth and King Terminal. In the Alternatives Analysis, this scenario is designated Option 0(c)A. The layout at the 4th and King Street Terminal contains four 1400-ft long platforms and eight tracks for HST, plus a single track with a 800-ft long side platform for Caltrain. Four approach interlocking “throat” tracks provide universal access to all station platform tracks. Each pair of station tracks is connected to a single track which curves around the bend to 7th Street, where there is an interlocking. This length of track between the platforms and the interlocking reduces the operational flexibility of the layout. The layout is shown in Figure 2.

Caltrain operations were assumed to originate and terminate at the TTC and therefore were not part of the analysis of this alternative. The operational analysis determined that this configuration would not meet HST service demands. The approach interlocking “throat” track configuration did not provide the throughput capacity necessary to support the forecast HST service levels. The configuration presented a potential “single point of failure” where one switch is the single access point to five platform tracks, thus impeding efficient operations by seriously limiting parallel movements into and out of the terminal.

3. **Joint Transbay Transit Center and 4th and King Terminal:** This alternative envisions a “shared use” (HST and Caltrain) joint terminal option including service to both the TTC and the Fourth and King Terminal locations, providing a total of eight platform tracks for the HST (4 at the TTC and 4 at Fourth and King) and a total of seven

¹ The term “interlocking” refers to the arrangement of tracks, turnouts and crossovers that allow trains to go between the main line tracks that approach the terminal and individual terminal tracks.

² A universal interlocking allows trains to go between any station track and any approach track.

platform tracks for Caltrain (2 at the TTC and 5 at Fourth and King). In the Alternatives Analysis, this scenario is designated Option 0(a)A. The configuration at the TTC provides three platforms for six tracks, two of which would be for Caltrain and four for the High Speed Train. The configuration of the tracks and platforms at the 4th and King Street Terminal provides two 1400-ft long platforms for 4 high speed rail tracks plus three 800-ft long platforms for five Caltrain tracks. This layout is shown in Figure 3.

The operational analysis found that this alignment provided sufficient parallel train movement capability thereby minimizing conflicts between arriving and departing trains. In addition, the number of platform tracks or “edges” provided by the combination of both terminals (8 for the HST and 7 for Caltrain) is sufficient to accommodate the assumed scheduled turnaround times for both HST and Caltrain.

4. **Fourth and King Stacked Station:** This alternative is a variation of the shared use joint terminal option described in Alternative 3 above. It envisioned an additional level of tracks and platforms at Fourth and King to increase terminal capacity, which could be a “fall back” option should Alternative 3 prove incapable of supporting the proposed service levels of both Caltrain and the HST. The results of the Alternative 3 operational analysis confirmed that the Alternative 3 terminal configuration could support the proposed service levels. In addition, the TJPA’s Program Management/Programs Controls team evaluated the technical feasibility of a stacked station at 4th and King, and found that it was technically infeasible (see attached memo). The regional HST team reviewed the TJPA analysis and concurred with their findings. Consequently, this option was removed from further consideration.

5A. **Beale Street Only (10 Tracks and Universal Interlocking):** Based on a conceptual design provided by Gensler architects (see Figure 7), a layout was developed to test the functionality of the proposed alternative. Starting near 4th and Townsend Streets, the alignment continues along Townsend Street until it reaches the Embarcadero. From that point the alignment turns northwesterly along the north edge of the Embarcadero until it reaches Beale Street, where it turns north to a stub-end terminal located between Beale and Main Streets. The alignment would be underground, as would the terminal. The profile of the tracks would be fairly deep (40 to 50 feet) as the tracks would need to pass underneath the Fire Department’s Auxiliary Salt Water Intake pipe which is located in Townsend Street between 2nd Street and The Embarcadero. The alignment also passes under the Bay Bridge between the anchorage at Beale Street and piers located at Main Street. The terminal would be located in partially vacant land in the two-block area bordered by Beale Street, Harrison Street, Main Street and Folsom Street.

This alternative consists of a 10-track terminal providing 8 platform tracks for the HST, 2 platform tracks for Caltrain and a universal interlocking at the throat. There was no change to the configuration at Fourth and King Street as it would not serve HST. This layout is shown in Figure 4 and a cross section is shown in Figure 4A. As shown in the cross section, the throat tracks that approach the terminal are located deep underground between the Bay Bridge Anchorage and Pier “A” located on the west side of Main Street. The structure would be within a “zone of influence” (the area receiving loads from these structures) of both structures, requiring extensive shoring to prevent the excavation for the subway structure from affecting the stability and potential movement of both structures..

As a requirement to minimize single point failures and to provide maximum operational flexibility a universal interlocking configuration was included so as optimize the movement of trains in and out of the terminal. However, to accommodate sufficient distance for the interlocking, the north end of the terminal was extended north to Market Street under property currently occupied by high rise buildings. Consequently, additional right-of-way would need to be acquired at substantial cost to accommodate this configuration. If the north end of the terminal were to be held to the current limits of the Transbay Transit Center and the original Gensler proposal, there would be insufficient distance between the south end of the terminal and The Embarcadero for the universal interlocking which would

affect the operational capacity of this terminal. For these reasons, this option was removed from further consideration.

5B. Beale Street Only (10 Tracks and Simplified Interlocking): This alternative is a variation of Alternative 5A with a ten-track terminal located within the boundaries of the original Gensler proposal. To achieve this, the interlocking at the throat was simplified downward from the universal interlocking. Not all station tracks are accessible from all three of the approaching main line tracks. A secondary interlocking is necessary for this layout to operate, and this reduces operational capacity. The layout is shown in Figure 5. The track configuration requires a wider structure within the zones of influence of the bridge structures than Alternative 5A. A cross section is shown in Figure 5A. Based on the operation analysis results for Alternative 2, which showed the inability of an interlocking design that provides single switch access to the platforms to support the lower train service volumes applied in the Alternative 2 analysis, it was concluded that an operations review of Alternative 5B was unnecessary, and it was removed from further consideration.

6. Joint Beale Street and Fourth and King Terminal: This alternative envisions a “shared use” (HST and Caltrain) joint terminal option including service to both the Beale Street and the Fourth and King Terminal locations, providing a total of ten platform tracks for HST (6 at Beale Street and 4 at Fourth and King) and a total of seven platform tracks for Caltrain (2 at Beale Street and 5 at Fourth and King). In the Alternatives Analysis, this scenario is designated Option 0(d)A. The configuration at Beale Street is an 8-track terminal (6 tracks for HST and 2 tracks for Caltrain) with a universal interlocking. The configuration of the tracks and platforms at the 4th and King Street Terminal provides two 1400-ft long platforms for 4 high speed rail tracks plus three 800-ft long platforms for five Caltrain tracks. This layout is shown in Figure 6. The subway structure under the Bay Bridge is wider than Alternative 5A but narrower than Alternative 5B. A cross section is shown in Figure 6A.

This option provides comparable operations capabilities to Alternative 3 (the joint TTC and 4th and King Terminal). The operational analysis found that this alignment configuration provides for sufficient parallel train movements to minimize conflicts between arriving and departing trains. The number of platform tracks or “edges” provided in the combination of both terminals (10 for HST and 7 for Caltrain) is sufficient to accommodate the assumed scheduled turnaround times for the HST and Caltrain within acceptable parameters of the operating assumptions.

7. Beale Street Only (12 Tracks): This alternative was originally proposed by Gensler Architects during the scoping period and modified later by TJPA, as shown in Figure 7. The main line tracks split in Townsend Street to allow a two-phase development of the terminal. The terminal has 12 tracks in total. There is a limited interlocking at the throat of the terminal. In addition, the second phase tracks in the Embarcadero crosses under the City’s Consolidated Sewer Outfall structure twice. The subway structure under the Bay Bridge is about as wide as that required by Alternative 6. A cross section is shown in Figure 7A. The TJPA’s Program Management/Program Controls team reviewed the alignment and found it likely to be technically infeasible (see attached memo). The regional HST team reviewed the TJPA analysis and concurred with the findings. Therefore, this alternative was not developed or evaluated further by the regional HST team. Instead, other options were developed as described above.



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DRAWN BY	
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IN CHARGE	
DATE	03-24-10



CALIFORNIA HIGH-SPEED TRAIN PROJECT
SAN FRANCISCO
 ALTERNATIVE 1: TRANSBAY
 TRANSIT CENTER (HST) ONLY
 AA ALTERNATIVE OB
 FIGURE 1

CONTRACT NO.	XXX
DRAWING NO.	
SCALE	1"=300'
SHEET NO.	OF



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DATE	03-24-10



CALIFORNIA HIGH-SPEED TRAIN PROJECT
SAN FRANCISCO
 ALTERNATIVE 2:
 4TH STREET AND KING STREET (HST ONLY)
 AA ALTERNATIVE OC
 FIGURE 2

CONTRACT NO.	XXX
DRAWING NO.	
SCALE	1"=300'
SHEET NO.	OF



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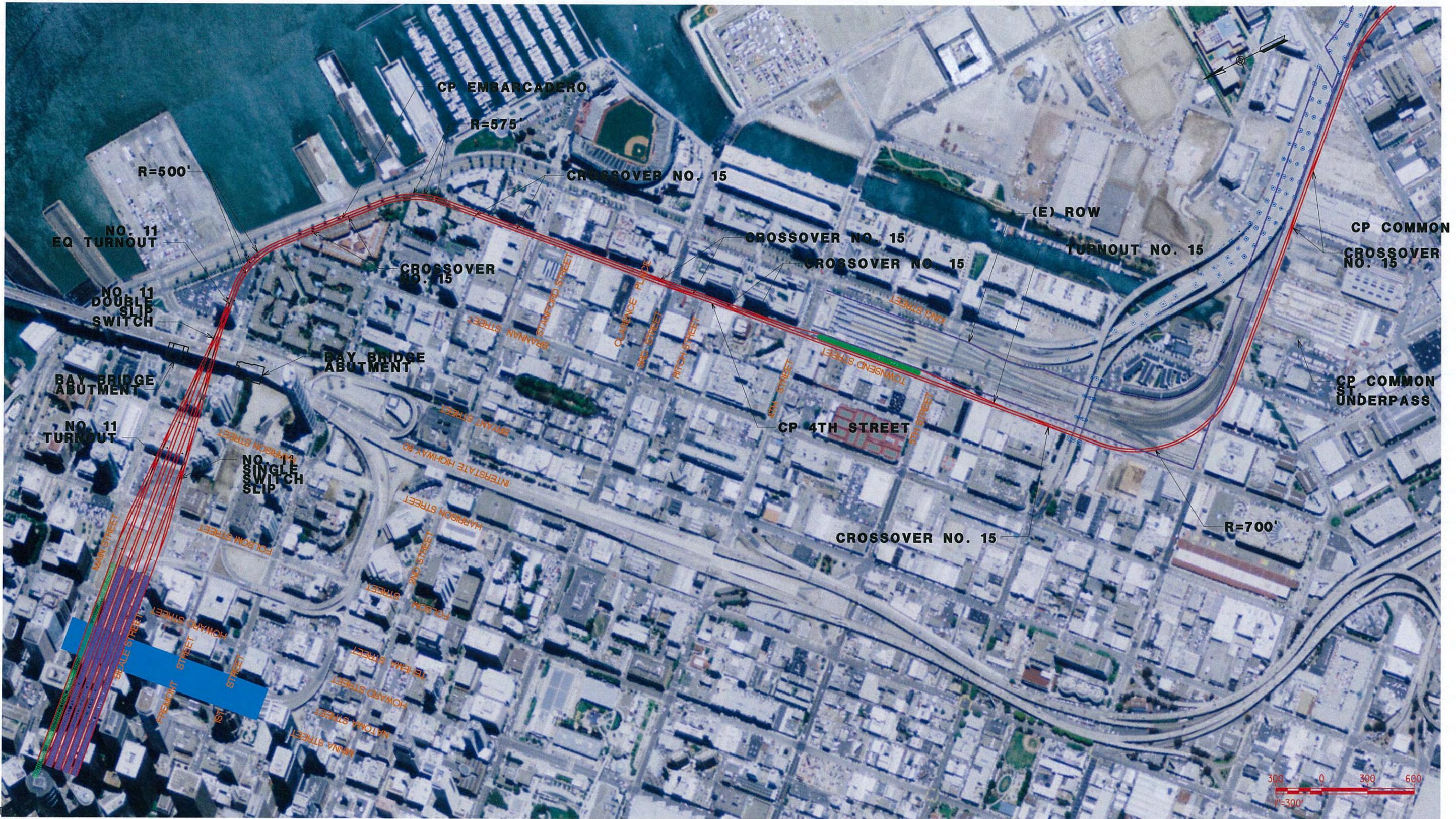
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IN CHARGE	
DATE	03-24-10



CALIFORNIA HIGH-SPEED TRAIN PROJECT
SAN FRANCISCO
 ALTERNATIVE 3: TRANSBAY
 TRANSIT CENTER
 AA ALTERNATIVE 0A
 FIGURE 3

CONTRACT NO.	XXX
DRAWING NO.	
SCALE	1"=300'
SHEET NO.	OF



NOT
 1. TURNOUTS NORTH OF 4TH AND KING ARE ON DIRECT FIXATION TRACK AND HAVE POINT OF SWITCH AT HEEL OF FROG OF PRECEDING TURNOUT.

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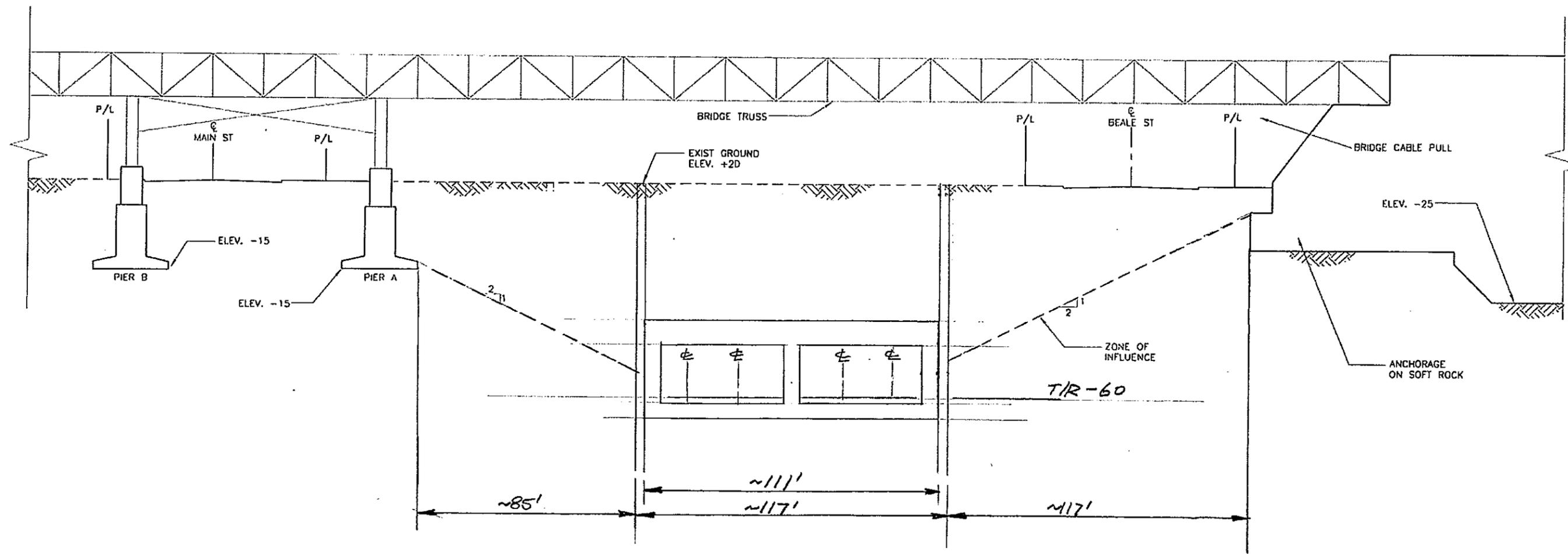
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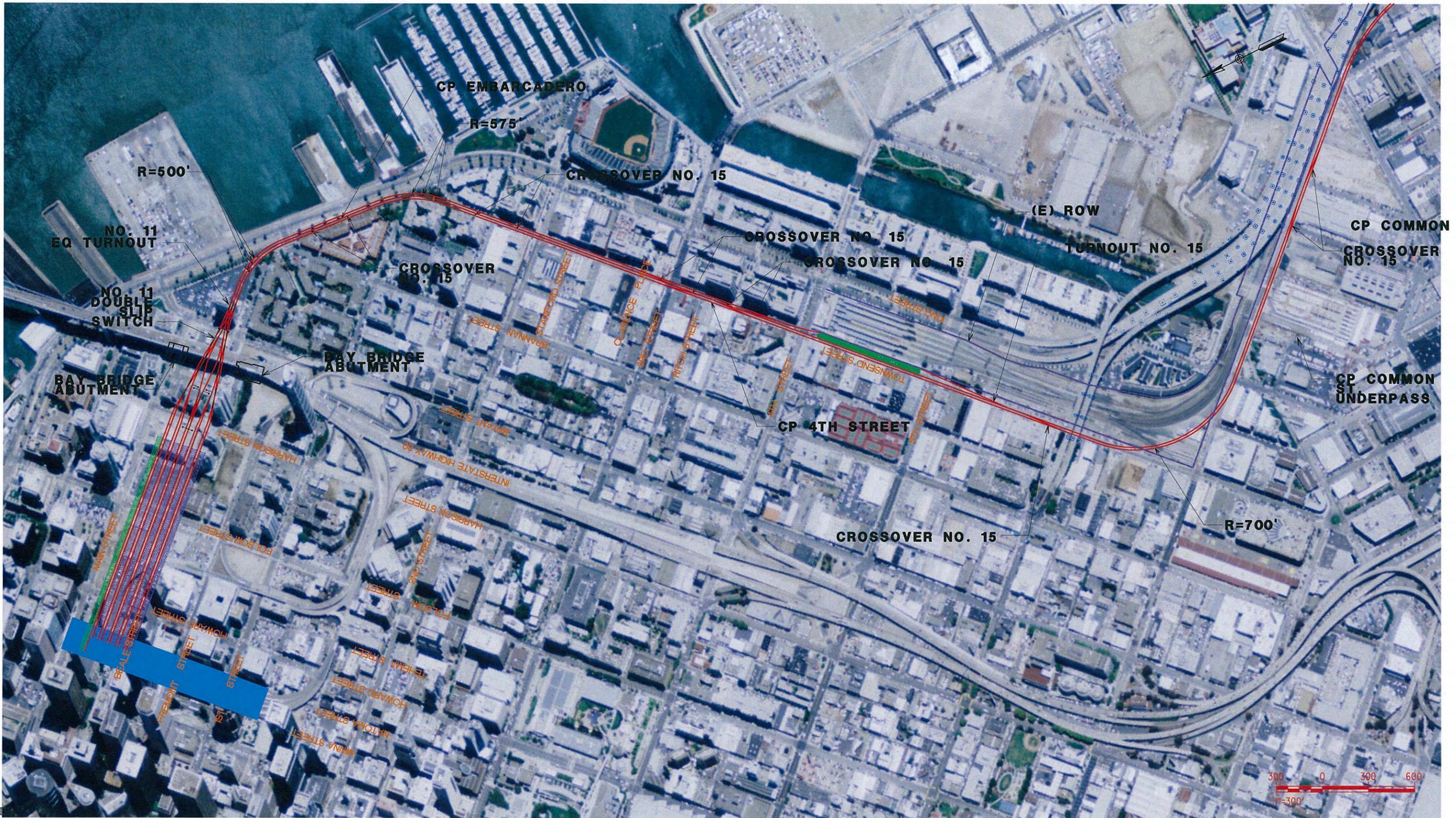


CALIFORNIA HIGH-SPEED TRAIN PROJECT
SAN FRANCISCO
 ALTERNATIVE 5A: BEALE STREET
 (ALL HST AND CALTRAIN)
 AA ALTERNATIVE OD
 FIGURE 4

CONTRACT NO.	XXX
DRAWING NO.	
SCALE	1"=300'
SHEET NO.	OF



ALTERNATIVE 5A
 BEALE STREET (ALL HST AND CALTRAIN)
 AA ALTERNATIVE OD
 FIGURE 4A



NO. 11
 1. TURNOUTS NORTH OF 4TH AND KING ARE ON DIRECT FIXATION TRACK AND HAVE POINT OF SWITCH AT HEEL OF FROG OF PRECEDING TURNOUT.

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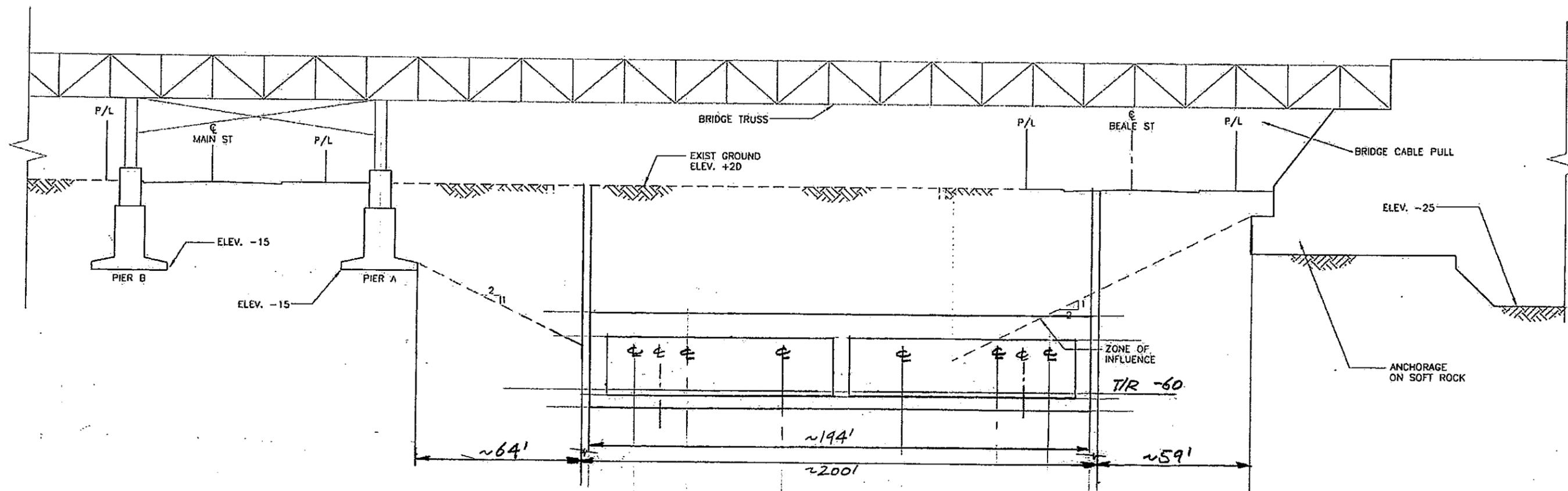
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DATE	03-25-10



CALIFORNIA HIGH-SPEED TRAIN PROJECT
SAN FRANCISCO
 ALTERNATIVE 5B: BEALE STREET
 (ALL HST AND CALTRAIN)
 AA ALTERNATIVE OD
 FIGURE 5

CONTRACT NO.	XXX
DRAWING NO.	
SCALE	1"=300'
SHEET NO.	OF



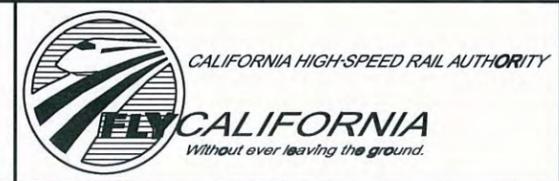
ALTERNATIVE 5B
 BEALE STREET (ALL HST AND CALTRAIN)
 AA ALTERNATIVE OD
 FIGURE 5A



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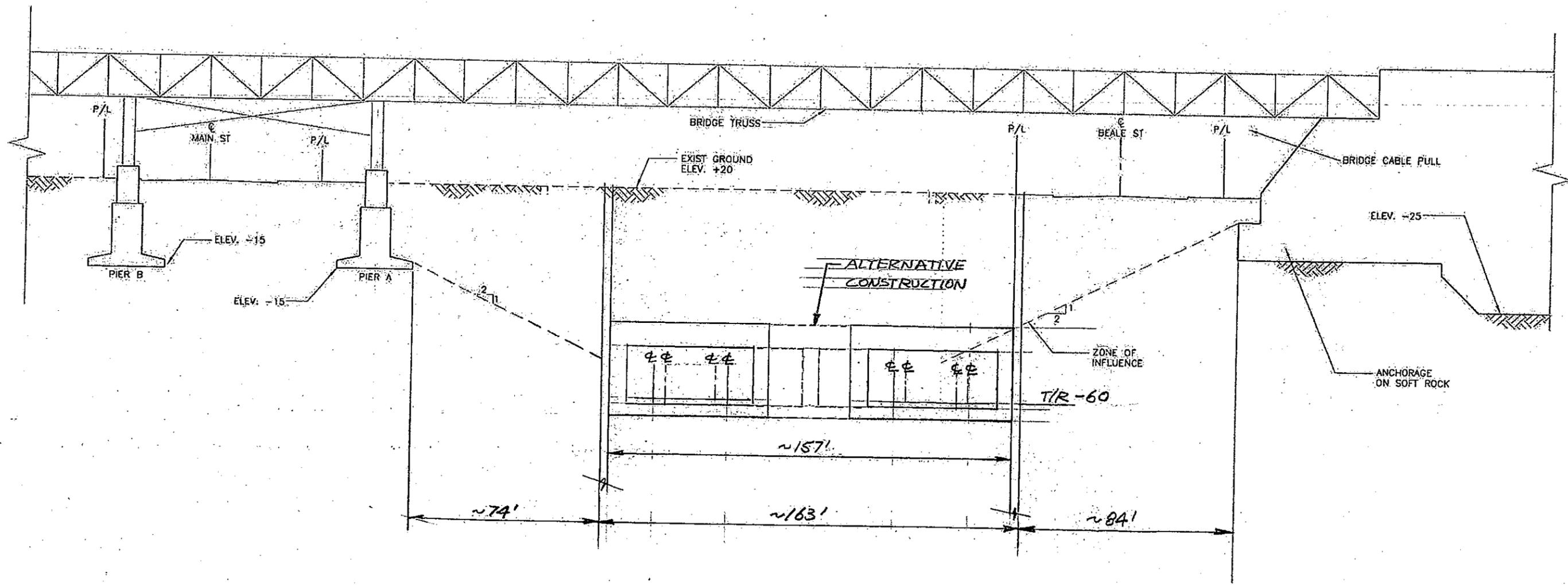
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DATE	03-25-10



CALIFORNIA HIGH-SPEED TRAIN PROJECT
SAN FRANCISCO
 ALTERNATIVE 6: BEALE STREET
 AND 4TH STREET AND KING STREET
 AA ALTERNATIVE OD
 FIGURE 6

CONTRACT NO.	XXX
DRAWING NO.	
SCALE	1"=300'
SHEET NO.	OF



ALTERNATIVE 6
 BEALE STREET AND KING STREET
 AA ALTERNATIVE OD
 FIGURE 6A

FOR STUDY PURPOSES ONLY



**ALTERNATIVE 7
BEALE STREET (ALL HST AND CALTRAIN)
AA ALTERNATIVE 0D
FIGURE 7**

CONCEPTUAL ENGINEERING REVIEW OF BEALE STREET
SAN FRANCISCO TERMINAL PROPOSAL
11/25/2009
PARSONS

